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Use Of Basic Science Education Books In Our School Program*

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In the Laboratory School of the University of Chicago we use the Basic Science Education Series as basic texts. The topic on which I have been asked to speak becomes then, "The Use of Textbooks in an Elementary and Junior High School Science Program."

In passing it should be pointed out that there is one major difference between a series of unit texts and a series of large books each designed to cover a whole year's work. The series of unit texts makes possible a flexible program. No rigid science program can fit schools in widely different areas, with different amounts of time given to science, and with different ideas on the part of the teachers and administrators as to where emphasis should be put.

Even within a given school it is important that the program be flexible. The time spent on science at a given level may vary from year to year. Classes vary in size and in average ability. Materials may be available one year that are not available at another. (A mother opossum which was given to us two or three years ago this spring made the study of mammals especially appropriate at that time). Moreover, pupils should have a part in planning the science program. It has become commonplace for a teacher who uses books containing a series of units to say, "Of course we do not follow the text and cover the units in the order in which they are presented there." In fact, not long ago I heard a county supervisor say that she would not tolerate in her county the following of a textbook through from beginning to end. Jumping about in a textbook is, however, not altogether fair to the readers or, for that matter, to the author of the text. For every unit in the book after the first one presupposes that each preceding unit has been covered. In unit texts each unit can be made completely independent.

* Presented at the annual meeting of *The American Nature Study Society*, Chicago, Illinois, December 27, 1947.

In our opinion there are various other advantages of having the text material in brochure form but they are not particularly important in a consideration of the part which textbooks play in helping children reach the accepted goals of a science program.

It is possible to teach science without books. Some of the goals can be reached more effectively through other means than through reading. The most effective way to develop ability to do critical thinking, for example, is doubtless to set up challenging situations, lead the pupils to recognize and state the problem, and guide them in working out the solution. Agassiz' famous dictum, "Study nature, not books," emphasizes the generally accepted idea that firsthand experience should play the major role in science teaching at the lower levels. In our Laboratory School we have a large amount of simple science equipment, some of it designed and built especially to suit our needs. We have many living things in the science rooms. Adjoining the school there is a garden which affords opportunity for every child in the first four grades to have a plot of his own and which includes a perennial garden cared for by the fifth-graders and a wildflower garden cared for by the sixth-graders. We have a very large library of visual aids —moving pictures, film-strips, kodachrome slides, and mounted pictures—and some transcriptions. We take trips to the planetarium and to the Museum of Science and Industry, and occasionally there are Saturday trips to the dunes or the forest preserves. What then is the need for books?

Science texts are made up of materials of at least two general types: content material, and suggestions for activities. Many textbooks include some guide-test materials. Our own series does not; such materials are incorporated in a manual and are given to the students in mimeographed form.

The content material includes straight factual presentations, stories of firsthand experiences with natural phenomena, of scientific exploration, and of the achievements of famous scientists, myths presented as evidence of man's early striving to understand his environment, and discussions of superstitions which we should have outgrown.

The function of the suggestions for activities is obvious. Incidentally, these suggestions for activities do not break the text. There is no justification for reducing the readability of the text by inserting such suggestions at the place where they would logically come. Because of individual differences, no two members of the group are likely to reach the suggestions at the same time. Since many experiments should be group demonstrations and since many activities, from the standpoint of economy in teacher effort, must be carried on at the same time by the whole group, it is better to have the suggestions for experiments and other activities separated from the body of the text.

Let us now examine some of the purposes which the content materials serve. No attempt has been made to state the roles served so that they are mutually exclusive.

One role of the text is to furnish answers to questions which have been raised by the students and which cannot be answered by observation or experimentation. In an astronomy unit, for example, these questions are sure to arise: Of what are the rings of Saturn made? Could anyone live on the other planets? Why do stars twinkle? How far away are the stars and the planets? Pupils cannot find these answers through first-hand experiences.

Through the text children can broaden their experiences within the areas of

science with which their class work is concerned. A class may work with electromagnets in the laboratory. Each child may make a magnet for himself. Electromagnets may be found at work in bells, buzzers, motors, and telegraph sets. The text can then describe for the class magnets at work removing bits of iron from the flour in a flour mill, lifting huge hot blocks of steel in a steel mill, helping magicians do some of their spectacular tricks, and breaking up great piles of metal junk with the help of skullcrackers. Children can be given firsthand experience with air-pressure phenomena. The text can take them up miles into the stratosphere and tell them about conditions of air pressure there. It can take them, too, underground in a caisson and show them air pressure holding back a river while a tunnel is being built. A class may examine a compass and carry on many simple experiments with it. The text can show how a compass acts at the North Magnetic pole. Fossils can easily be examined by children in museums and in laboratories. The text can carry the children backward in time and reconstruct for them the conditions on the earth at the time when the fossil plants and animals were alive.

One of the abilities recognized as among the objectives of a science program is the ability to generalize from assembled data. In developing this ability the text material designed to broaden children's firsthand experiences plays an important part. One of the major flaws in the science teaching of today is that children are often allowed—even urged—to generalize from insufficient data. To illustrate, a group, we will assume, is studying fishes. In the aquariums there are fishes of several kinds. Ways in which fishes are fitted for living in water are discussed. The children, from observation of the specimens at hand, are very likely to jump to the generalization that, as a means of adaptation to their environment, all fishes have fins. Clearly it is not sound science-teaching to allow the class to reach such a generalization from the observation of the necessarily limited number of fishes at hand. Pictures and reading material must be depended on to furnish the additional data needed as a basis for such generalization.

Problem-solving makes up an important part of any good science course. In problem-solving the text helps by suggesting problems, furnishing data in addition to that provided by firsthand experience, and checking conclusions.

In this connection it may be well to point out that, contrary to various recommendations, our texts are not organized in the form of problems. Setting up a text in such a manner we consider simply paying lip service to scientific method. Problems, unless they are formulated by the children, are not meaningful. Moreover, stating the problem is an important step in following the scientific method of problem-solving. Children should not be deprived of practice in this step.

As an example of how the text can raise problems, the inside covers of *Magnets* show the magnetic field around two magnet arrangements. The two patterns raise the problem of how they could have been produced.

Predicting results is often an element in problem-solving. The text helps here. A class, let us say, is trying to predict the order in which the marbles drop from a conductometer. To do so, they must know something about the relative conductivities of the various metals in the conductometer. They get the necessary information from the text.

As an example of how the text helps in solving problems, let us suppose that a fourth-grade class is planning its gardens. The text furnishes much needed

data about how various plants are propagated, whether they are annuals, biennials, or perennials, what conditions of soil, moisture, and temperature are necessary, when they bloom or bear fruit, how tall they are, etc.

An important role of the text is to check conclusions reached by class discussion. A group, for example, has been given some chemical thermometers. Each member of the group reads his thermometer. Some of the readings are in the 70's while others are in the 20's. Temperatures of several things are taken—water from the cold-water faucet, water from the hot-water faucet, the students' hands, etc.—and the same wide variation in readings is discovered. The class suggests various explanations. The conclusion is reached that there must be different ways of marking thermometers. The class then reads from the text a section which explains about Fahrenheit and centigrade scales.

Of course, the teacher might do such checking orally. Checking by consulting the text is likely to make a deeper impression. Besides, it has the advantages of familiarizing the members of of the class with the vocabulary of the unit in print. Moreover, if a teacher forms the habit of asking a class to check its conclusions by reading, he or she will not be guilty of a certain common violation of the rules of good science teaching. Often a teacher, after the explanation of some phenomenon has been offered by one member of a group, asks, "How many agree?" If the whole class agrees, the agreement of the class is likely to be accepted as evidence that the explanation was right. Accepting the opinion of a class as evidence that a conclusion is right is poor training in scientific method no matter whether the conclusion reached is right or wrong. A class must be made to understand that questions of science cannot be settled by a show of hands. Progress in science has characteristically been made by the lone scientist who did not agree with the common opinion.

It goes without saying that children should not be led to regard printed material as infallible. They should, on the other hand, realize that most of the material in science books has been written, or at least checked, by recognized authorities and has for that reason considerable weight.

Although in developing ability to solve problems, in a scientific fashion, we must put chief dependence on the actual solving of problems, reading of how various problems have been solved plays a part too. Such stories as those of Darwin's patient accumulation of evidence for nineteen years before he published his book about the origin of species and of the work of the young scientists who succeeded in making synthetic quinine cannot fail to contribute something to the understanding of true scientific method.

Stories of scientific achievement as well as discussions of unfounded beliefs help make clear to the children what is meant by scientific attitude. No one knows the extent to which an understanding of a scientific attitude is effective in the development of a scientific attitude. It is certainly an initial step.

Text material designed to broaden children's experiences must be the chief dependence in the attainment of one of the goals of science-teaching: an appreciation of the part which science is playing in the world today. From firsthand experience children can get no adequate picture of its importance.

Although identification is seldom recognized as an end in itself in science-teaching, being able to name plants, animals, rocks, and stars we see helps build a feeling of security in one's en-

vironment. To a considerable extent our texts serve as identification guides.

Another role a text serves is to re-present subject matter that has first been presented orally. To illustrate, an explanation of the regular recurrence of the phases of the moon, an easily observable phenomenon, is rather complicated. The teacher, let us suppose, has developed an explanation in an oral discussion with the help of charts and models. For some children the one presentation will suffice; for others repeated presentations will be necessary. Adequate text material will re-present the explanation without subjecting the faster members of the group to the boredom inevitably attendant on repeated oral presentations.

Finally, the text material provided, as well as the various activities of the science program, serves to broaden children's science interests.

In conclusion, I should like to list a few very specific ways in which you might find our unit texts being used if you were to visit the Laboratory School. An eighth-grade class has just seen the film, "Control of Body Temperature." From *Keeping Well* the class is picking out statements which the film illustrated.

Each child in a fourth-grade group has been given a card with direction for some kind of simple demonstration having to do with the air. As soon as he completes the demonstration the other members of the group select from the core ideas listed at the end of *The Air About Us* the idea he was demonstrating.

A fifth-grade class, after a period of direct teaching in a unit on "Foods", has reached the stage of independent study. They are working through a set of mimeographed exercises. The exercises call for real reading—not mere hunting for key words.

A seventh-grade group is making models of geysers, young, mature, and old river valleys, faulted mountains, and various other physiographic features. They are getting the needed information from *The Earth's Changing Surface*.

A fourth-grade class is playing a classification game. Before each child there are six books—*Reptiles, Toads and Frogs, Insects and Their Ways, Fishes, Animals We Know,* and *Birds.* The leader names an animal pictured in one of these books. Each child scores a point if he picks up the correct book. He cannot change his mind. Of course, he finds out whether he has the right book by finding the picture.

A fifth-grade group has just reached the conclusion that, if there were no green plants on the earth, we should have nothing but water and salt as food and could not live. They are checking the conclusion by reading *Plant Factories*.

A sixth-grade group has guessed which of these plants—onion, asparagus, lily, petunia, pineapple, long moss, nightshade, and potato—belong in the same family. They are consulting *Flowers, Fruits, Seeds* to see how nearly right their guesses were.

Each member of a fourth-grade class has before him a box of rock specimens and a set of labels. By looking at the pictures and reading in *Stories Read from the Rocks*, he is matching specimens and labels.

A seventh-grade group has been given a set of true-false questions about adaptation to environment. After each statement they are, in addition to marking it right or wrong, listing the page and paragraph in *Adaptation to Environment* which backs up their rating.

Obviously such specific examples could be multiplied endlessly. But the few that have been cited will give you some idea of the part our basic science texts play in our science program.

Embryology In High School Biology

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Few subjects which we teach in our schools today are more closely connected to one's everyday life than biology. It should, therefore, be made an integral part of life and not an entity apart from it. Embryology, in many high schools, receives too little attention. To teach biology without including this aspect is to leave the student with an incomplete understanding of life's story. Likewise, limiting this work to a verbal status is not satisfactory. Nor are pictures a substitute for reality. In addition to being an absorbing subject, offspring development, is the framework upon which biology is based.

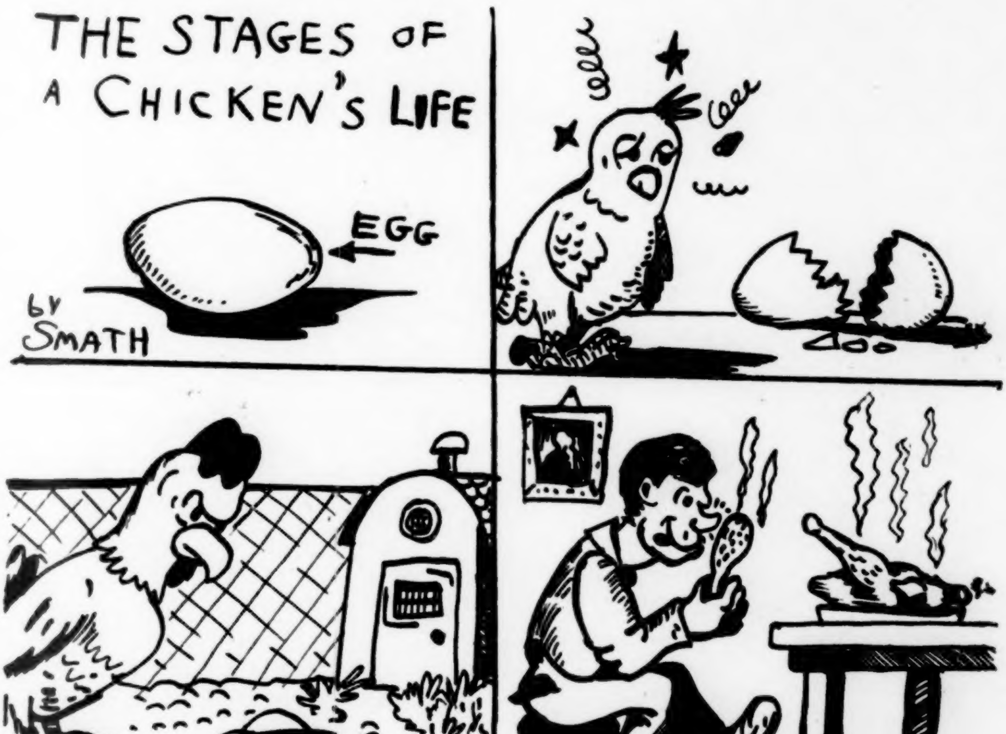
Embryology may conveniently be demonstrated by incubating chicken eggs in the laboratory. A small incubator is inexpensive and, with care, its use will extend through many years. Also, excellent publications dealing with this phase of biology, both book and magazine forms, are available to teachers for reference. It is not the purpose of this article to point out the successive stages of development of an embryo. Rather, I wish to suggest a method of extending this work beyond the classroom.

When the word spread throughout our school that "they" were going "to

hatch" eggs in the biology laboratory, many students not enrolled in the subject contacted me and expressed an interest in the proposed activity. Their curiosity, I felt, should be satisfied. Accordingly, an announcement was made that an exhibition of the development of the chicken would be on display, at stated intervals, in the school library. A table with an appropriate sign was arranged. To facilitate observation of the specimens, a four-inch magnifying lens was attached to a lampstand with a burette clamp. Typed information and pictures accompanied each exhibit. Incubation timing was carefully considered and carried out. Two dozen fertile chicken eggs were purchased and the project was under way. The eggs were incubated in the laboratory. From this point a dual program was followed. In the classroom, the biology students learned about selecting suitable eggs, temperature control, aeration, moisture importance, turning the eggs, testing, time elements, observations, and supplementary reading. The library part of the program was less detailed. It consisted of the following:

First Day. An unbroken egg was placed under the lens. A brief explanation of the structure and purpose of the shell was typed and placed alongside the lampstand.

Second Day. An egg tester, with a fertile egg in position, was mounted on the table and connected to an electrical outlet. A large cardboard, folded like a cone, darkened the area around the egg. A peep hole was provided. Again, instructions informed the observers what to look for.



Third Day. A fresh, unincubated fertile egg was broken open and the contents placed in a Petri dish. The egg was arranged with the chalaza shown. A large labelled drawing of the egg content was available for student reference.

Fourth Day. The first incubated (three days) egg was opened for observation. The embryo was plainly visible. Also, the circulatory system was in evidence.

Following this, eggs were opened at announced intervals until the chicken was well formed. They were then permitted to hatch without interruption. True to prediction the live chicks made their appearance on schedule.

It seems unnecessary to emphasize the interest and value which accompanied this activity. However, it may be pointed out that ideas became real facts for the students. Obviously, it was good public relations for the biology department.

Student interest in the exhibit was shown by the many and varied cartoons which appeared on the table. Two accompany this article.

Teaching Taxonomic Principles in Elementary Biology

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As a high school student in Kansas City, Kansas it was my privilege to know a retired clergyman who had been associated as a young man with the University of Kansas Geological Survey. The early interest he had had in paleontology had continued throughout his life, and he still maintained in his home a large collection of fossils, mostly from the limestone deposits in the neighborhood of Kansas City. With another boy of my age I used to visit him on Sunday afternoons and hear him tell us about the fossils in his collection. His enthusiasm was contagious and we learned a great deal through this informal tutoring. Of course the fossils had no common English names, and we soon acquired a real and satisfying facility in the use of their scientific names. Many of these names are still with me, though thirty-odd years have elapsed.

Scientific names are neither complicated nor forbidding. They are actually composed like common names, but are a language we do not use familiarly. Common names usually consist of two parts, a noun and an adjective. We do not call a tree merely a maple or an oak; it is a hard or soft maple, a white or post or burr oak. We use a generic term, which places the plant or animal in its proper group, and we modify that with a specific term which briefly distinguishes the one in question from others in the same group. A noun and an adjective—these constitute a common name in any modern living language like English. This same combination, in unchanging Latin form, is the scientific name.

While living in the Orient some years ago I had an experience which made this general principle very real. One day as I stepped down from the porch of our home in Bangkok I noticed the three year old daughter of our gardener playing on the sidewalk. She was poking some large red ants with a stick, playing with them. I recognized them as of the common genus Oecophylla, a group note-

worthy in southern Asia for use of their larvae as mucilage tubes in cementing the edges of the living leaves which compose their nests. Overcoming my normal hesitancy in trying to speak Siamese before those who used it naturally, and obeying a sudden impulse, I pointed to an ant and asked the little girl, "Ne arai"?—"What is it"? Her answer came to me as a revelation, not only of the way all peoples name natural objects, but of the way the scientists name an object and classifies it at the same time. Her answer was a binomial, "Mot deng." We translate that, "red ant." It was a noun modified by an adjective, the noun "mot" (meaning ant) and the adjective "deng" (a reddish brown color). It was the common name for a common species, and not so discriminating as the scientific name would have been; but it did more than provide a name. It placed the insect in its general category by calling it an ant; then it distinguished it, though inadequately to a scientist, from other ants. These two aspects of nomenclature are just as characteristic of the language of everyday man as of the biologist.

In the teaching of taxonomy, to either beginners or advanced students, these are the two aspects to emphasize, nomenclature and classification. We do a fair job in introducing many of the terms used in classification. But we are negligent, as a rule, in teaching the principals of nomenclature, and thus we pave the way for the careless descriptions of materials used by so many experimental biologists. Even those students who are destined to become professional biologists receive no guidance in their interpretation of such a simple convention as a scientific name.

Of course nearly every textbook gives an example of a scientific name, ***Homo sapiens*** perhaps, or ***Felis domesticus.*** This is usually introduced with a half-hearted attempt to teach the categories of classification. The explanation of the scientific name itself, however, usually stops with a statement that the first word is the generic and the second the specific name. There is no mention of the grammatical structure, that the genus name is in the singular number (whereas all higher categories in classification are expressed in plurals). There is no mention that the generic name is a noun and the specific name must modify it grammatically either as an adjective or as another noun. Furthermore there is seldom any mention of the fact that one scientific name and one only is accepted internationally as valid for a particular species. What more important reason is there for a taxonomic nomenclature? The principle of priority, viz., that the name selected is the first one used, is seldom mentioned. Many a professional biologist who ought to know does not know the usage with reference to authors' names after scientific names. And, strange as it may seem, an occasional student doesn't even realize the fact that scientific names have meaning, that they are in effect, as originally intended by Linnaeus, condensed descriptions.

It isn't necessary to make a taxonomist of every student in biology. It isn't even necessary to devote much time to the matter. But some thought and care in introduction of taxonomic principles, particularly as related to nomenclature, is essential. This will require a little more time than is given in most classes, but one full class period should be sufficient. The principles to be included might be listed briefly as follows:

1. Each species of animal or plant can have only one scientific name, regardless of the number of common names.

2. This name is constructed according to codes accepted interna-

tionally by zoologists and botanists.

3. These codes provide for a form in which the genus name is a substantive in the singular nominative and the species names must be in grammatical agreement.

4. The valid name for a species is the first name applied to it; if other scientific names are later given, inadvertently or otherwise, they are taxonomic synonyms.

5. The author's name after a scientific name is the name of the person who first named the species; if his name is in parenthesis he did not use the entire combination, e.g., he used the species name with a different generic name.

6. Scientific names are meaningful.

All of these principles may be easily illustrated in one class period, using a single group of animals or plants with which the instructor is personally familiar. And they are important enough and basic enough to taxonomy in general (which is not limited to biology) to deserve the necessary time.

In my own case I find that birds provide the simplest group to use. A small but varied collection of mounted birds (or skins) can be used successfully as a demonstration. They are grouped on the demonstration desk so that their nearness to each other is proportional to their nearness in classification. The ducks are in one group, the herons in one group, the woodpeckers in a group, the perching birds in a group. These represent the orders. The passerine birds are further grouped by families, the Icteridae are in one small group, the jays in another, the warblers in another. In these families it is possible to select two or three genera with several species each, and with these illustrate classification at the species level as well as the structure and meaning of scientific names.

Several interesting cases may be picked among the Icteridae. The principal of priority is nicely shown by Linnaeus' name for the eastern meadowlark, *Alauda magna*. As larks go, and Linnaeus considered this bird a lark (Alauda) on the basis of descriptions from the American colonies, it is large. But it isn't a lark, and when Vieillot placed it in a different genus and family the name *magna* ceased to be appropriate. Nevertheless, because this name was the first one given, we call the meadowlark *Sturnella magna* (Linn.). The earliest ornithologists, however, did not recognize the differences between the eastern and western species. Because of this oversight, Audubon named the western meadowlark *Sturnella neglecta*, meaning the Sturnella which had been overlooked. Thus with these two related species several interesting principles can be illustrated.

Many names have just such interesting histories. Many others are thumbnail descriptions that are amazingly significant. The name of the red-headed woodpecker, *Melanerpes erythrocephalus*, means "red-headed black creeper" —a lot of description in two words. *Xanthocephalus xanthocephalus* reiterates "yellow-headed yellow-head" for the yellow-headed blackbird. And, of course, there are numerous examples of species named for distinguished scientists, *Dendroica auduboni* (Audubon's warbler), for example, literally "Audubon's tree-dweller." Geographic names are moderately common, too, e.g., *Carpodacus mexicanus*, literally the "Mexican fruit-biter," our common house finch or linnet. Descriptive names, names honoring individuals, names of geographic origin, all can be illustrated very simply in a well-planned demonstration program which should serve to

fix in every student's mind the fact that scientific names are meaningful. If the examples are carefully selected all the principles mentioned can readily be demonstrated.

Meanings of scientific names are not always readily found, but many can be located with a little intelligent search in a good unabridged dictionary. The best source for meanings of American bird names is the "Key to North American Birds" by Elliott Coues, a classic no longer in print. There are, however, several good general sources: JAEGER, EDMUND C., *A Source-Book of Biological Names and Terms* (Charles C. Thomas, Springfield, Ill., 1944); MELANDER, A. L., *Source Book of Biological Terms* (Department of Biology, City College, New York, 1937); WOODS, ROBERT S., *The Naturalist's Lexicon* (Abbey Garden Press, Pasadena, Calif., 1944), and its *Addenda* published by the same press in 1947. These are etymology source books. One finds in them the meanings of the Latin and Greek roots whose combining forms are the building blocks of scientific names. For those interested in a concise authoritative summary of the principles of taxonomy we have *Procedure in Taxonomy,* by EDWARD T. SCHENK and JOHN H. MCMASTERS (Stanford University Press, 1936). Perusal of the last named and one of the other three will introduce the biologist who feels he has a limited background in taxonomy to an interesting and valuable point of view. Whether he becomes a taxonomist or not is immaterial; he will begin to appreciate the importance of taxonomy as a basic tool in our science, and will acquire an understanding of the techniques involved. I am sure he will see how important it is to give every biology student a healthier attitude toward taxonomy and an appreciation of its necessity and its methods.

Advanced Biology

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In the Autumn of 1935, the course in biological science at Lake View High School was reorganized. The older formal courses of a year each in Botany and Zoology were replaced by a year of elective Biology (I and II) and a year of advanced work in Botany and Zoology. The latter have for administrative purposes been called Biology III and IV. Each of the four courses extends seven hours a week for twenty weeks, and all four are offered each semester. A year of required General Science is a prerequisite and the three years form a major sequence. About seventy-five percent of the second year students now elect beginning biology and the number of classes in advanced biology has increased to seven. The enrolment in Chemistry and Physics has also increased during the twelve year period.

In setting up the new courses in advanced biology, it was felt that this was an unusual opportunity to do constructive work. The material offered and the methods used should make the course of the greatest possible value to the student from the personal, philosophical, occupational and social standpoints and especially as a scientist in training, a consumer, and a citizen about

to become a voter. The students who elect the course are, in general, a select group. Many have chosen professions in the biological field and are diligently preparing for them. Excellent library and laboratory facilities as well as text books in secondary botany and zoology are available. It has been necessary to outline much of the work and to publish in mimeograph form many of the topics, particularly those that have a local aspect. Information obtained from students at the end of each semester has given some guidance as to the parts of the course found difficult and the fields most interesting and satisfactory to them. A study of their experience and success in their college and professional careers has been carried out. Their reports are enthusiastic.

A year's work in Chicago high schools is divided into eight quarters of five weeks each. These were used as guides in outlining the course. Since much of the elementary botany and zoology has been carried in previous courses, it remained to continue the educational spiral at a higher level in both fields.

The first ten weeks in Biology III (Botany) is devoted to a review and development of technical botany. At the close of the first two weeks of microscopic plant histology, each student must pass a practical test in the use of the microscope and in the identification of plant tissues. This is followed by plant physiology and ecology. Demonstrations of colloids and of the character of plant processes and constituents are are given as special projects by the instructor or by groups of students. Ecology includes a study of the life realms and of the North American life zones. Weed study (100) is emphasized in the fall and flowers (50) in the spring. Identification of trees by their leaves and in winter condition is carried out. Each student germinates a number of seeds and studies their development. Field trips to local areas for collections and to more distant areas for observation and ecological studies are made. From time to time, visits are made to conservatories, green houses, flower gardens, museums, seed stores and nurseries. Plant taxonomy and the history of botany are developed topically. This part of the course closes with a study of the algae and of metagenesis in moss, fern and flowering plant.

The second ten weeks are devoted to applied botany. It begins with a study of local and state geography and geology, soils, hydroponics and water supply. A laboratory period is given to the study of a government topographic map. Then follow studies of national and state forestry and of the major crop plants. In each of the latter, history, structure, production and use with special methods of plant breeding and culture are emphasized. A survey of garden, fruit and ornamental plants and of tropical fruits is made from lists, seed catalogs, and government reports. Special topics such as sustenance homesteads, city vegetable gardens, house plants, lawns, landscape gardening, rock and water gardens are considered.

In advanced zoology (Biology IV), the first ten weeks are devoted to an exploration and review of the subject from the high school level. During the first two weeks, some thirty tissues, chiefly temporary preparations from the frog, are studied microscopically. Prepared slides of a number of human tissues are examined with the projection microscope. This is followed by such special topics as mitosis and segmentation leading to taxonomy and a discussion of variation, inheritance, evolution and anthropology. Outlines are pre-

pared for the dissection of typical animals and students identify structures from drawings furnished them. A written outline of the topics studied and of the sections of the text covered is required each quarter. Each student who receives a grade of excellent or superior must, in addition to completing the required work in a satisfactory manner, carry out some special inquiry or project in the field. Topics and activities are suggested and materials furnished where possible. A large collection of classified material on biological topics has been accumulated. Detailed reports on visits to museums, aquaria and zoological gardens are accepted as projects.

The second half of the term is divided into six weeks of study of microorganisms and four weeks of human anatomy and physiology. In Bacteriology a special didactic and laboratory outline has been prepared. Each student makes up media, grows one or more of the laboratory cultures, examines temporary and permanent slides, reports on infectious and contagious diseases and carries out one or more practical problems. The lectures include technical bacteriology, hygiene from the personal and public standpoints and the bacteriology of air, soil, water and sewage, milk and other foods. Field trips to the health department, sewage disposal works, medical schools, biological laboratories, hospitals and milk bottling plants are made from time to time. The last four weeks of human anatomy stresses organology, physiology of blood and circulation, of muscle and nerve, special sense and reproduction. Two periods are spent in an exploration of occupations in the biological field. This includes the study of a college catalog, the classified city directory and government publications. Thruout the course, conservation of natural resources is emphasized.

The locale of such a course in a large city is in some respects a disadvantage, for it must be to some extent artificial. Thus, we must study the growing of corn and the breeding of cattle or the keeping of bees without going thru the actual experience. Thruout the course, each student is encouraged to develop one or more nature hobbies and the activities of such groups as the microscopical, ornithological and aquarium societies are brought to their attention. A small, but active, biology club has been carried on by work in free periods or after school.

At the close of twelve years in charge of this work, I feel that it has many advantages and that administrators and biology teachers should seriously consider the establishment of similar courses in advanced biology. We live in a scientific age and a vast field of advanced pure and applied biological science awaits the pioneers who can seize the opportunity for preparation and service. This work is not beyond the capacity of the third and fourth year students in our secondary schools.

A Science Fair

On Monday, April 19, I had the opportunity and very distinct pleasure of attending a science fair at New Castle, Indiana.

Every grade throughout the entire public school system of New Castle was invited to prepare an exhibit for competitive showing. There were eleven classes of competition as follows:

Primary group (or room): Grades 1–2–3
Intermediate group: Grades 4–5–6
Junior high school group: Grades 7–8
Senior high school group: Grades 9–12
Elementary science clubs
Junior high school science clubs

Senior high school science clubs
Individual entries:
Elementary, 1–6
Junior high school
Senior high school
Junior and senior high school clubs

There were eight divisions covering science principles in biology, chemistry, physics, general science, etc. For example, 2-P was the title for a primary group demonstration on conservation; class 4-CE, an elementary group demonstrating mining, industry, and farming; and 3-CJ or 3-CS would designate a display dealing with men of science and prepared by a junior or senior science club respectively.

The spadework for this fair was done a couple years ago when Mr. Joe Craw, New Castle Superintendent of Schools, and Mr. Lester O. Rear, of the New Castle Conservation Club, began to think together of some method of improving public interest in conservation. It was decided to try a pathway to the parents' interests through their children, and it was felt that science provided the logical approach. Thus it was demonstrated in one instance how classroom science can be closely integrated with everyday problems.

Mr. Craw secured the services of a stellar biology teacher, whose background of effort and achievement is well known throughout Indiana. Formerly one of Indiana's state park guides, she made thousands of friends and gained the confidence of park visitors through her enthusiasm and ability in nature lore.

Miss Edna Banta went into the New Castle school system as science supervisor and source consultant. Through her efforts and with the cooperation of other teachers, the first annual science fair of New Castle was held in the high school gymnasium. More than one hundred booths, arranged according to the classes and divisions mentioned, filled the gymnasium.

A committee of ten, with Dr. Robert Cooper, Ball State Teachers College, as its chairman, worked diligently for some four hours to determine first, second, and third places, and to award proper ribbons. Other members of the judging committee were: Howard Michaud, Forestry Division, Purdue University, Lafayette; Prevo Whitaker, University School, Indiana University, Bloomington; Nettie Wetzel, Sixth Grade Teacher, Richmond City Schools; Florence Borror, McKinley School, Muncie, Indiana; Mary Cedars, Grade School Teacher, Kokomo City Schools; Lester O. Rear, Conservation Club, New Castle, Indiana; Mrs. Chesley Juday, President, Garden Club, New Castle, Indiana; William Smith, County Agent, New Castle, Indiana; and Helen Johnson, Henry County Home Demonstration Agent, New Castle, Indiana.

These people, representing a broad area of interests and experience, were in hearty agreement as to the value of such a project. It is to be hoped that this is the beginning of a long series of annual functions of this nature in New Castle and that such activities may spread to other school systems. I am sure that Miss Banta, Mr. Craw, or any of the other planners of this Fair would be more than willing to provide complete information for the procedure for a science fair. I note that they used suggestions from "Children's Science Fair of American Institute."

P. L. Whitaker,
University School,
Indiana University

INDIANA BIOLOGY TEACHERS

A field day program for the biology teachers of Indiana was held on Saturday May 1 at Versailles State Park, Versailles, Indiana. The meeting was sponsored jointly by the Indiana section of the NATIONAL ASSOCIATION OF BIOLOGY TEACHERS and the biology section of the State Teachers Association.

The program was arranged by Dr. J. E. Potzger, Butler University, Indianapolis, who is also president of the CENTRAL ASSOCIATION OF SCIENCE AND MATHEMATICS TEACHERS. The following program was attended by sixty biology teachers:

Conducted hikes—

9:00–11:00 AM Birds—Spring Flowers—Oak Forests—Sweet Gum Forests. Leaders: Mildred Campbell, Shortridge High School, Indianapolis; Sidney R. Esten Broadripple High School, Indianapolis and Dr. J. E. Potzger, Butler University, Indianapolis.

11:15–12:00 M Short Business Meeting, Noble Waitt, President Sheridan, Indiana.
Address: "I Am A Teacher Of Biology." Dr. J. E. Potzger.

1:30– 2:00 PM Lecture on Guatemala—Exhibit of Art Work, Trinkets, Wearing Apparel, Etc.; Mrs. Helen Aufderheide and Miss Florence Geisler, Science Teachers, Indianapolis.

2:30– 3:30 PM Fossil Hike to Rock Outcrops in Laugherty Creek.

4:00– 4:30 PM Exhibits and Explanations of Teaching Aids; mounted wild flowers, insects, bird nests, pictures. Mrs. Helen Aufderheide and Miss Florence Geisler.

A check list of the flowering plants that bloom in April in the park was distributed by Dr. Potzger. This proved a valuable aid to those interested in the spring flora. The following description of the area was also included:

"The park is located in Ripley County. The underlying rock is Ordovician for the eastern half of the county and Silurain for the western half. The whole county was glaciated by the Illinoian glaciation. This was followed by two other periods of glaciation, known as the Early and Late Wisconsin. Neither of the latter two reached as far south as Ripley County. Glacial till from the Illinoian covered most of the bedrock, but during the time which elapsed since glaciation, creeks and rivers have cut through the old glacial material and even deep into underlying bedrock. This is very evident in Laugherty Creek here in the park as well as in the small stream cutting of the various ravines. Here in the park, rock outcrops are in the Ordovician rock strata. One of the most striking strata is the bluish shale in which are embedded great masses of sea life. The shells are mainly brachiopods, the ring-like short stems are crinoid stems, and the corals and bryozoa are also common. If you are fortunate you may find the ancestors of the crayfish, called trilobites. The soil of the county is light grey and represents the leached clays of the Illinoian glacial age. According to Dr. Malott, the eastern half of the county is in the Dearborn Upland which slopes into the western half, known as the Muscatatuck Regional Slope. Maximum altitude is 1007 feet, and the average is 885 feet."

Biology Laboratories

I HAD SOME PETRI DISHES, doing culture service, which occupied much needed laboratory space on one of the tables. I was afraid to stack these dishes for fear they would be knocked over. A few pound coffee cans and a pair of tin snips did the trick. With the snips I cut a deep two inch wide "U" section from the side of each can. These cut cans now serve as Petri dish racks. Each dish is accessable thru the cut side of the rack. To save your fingers from sharp edges file the rough spots. Paint the outside if you wish but the tinned inside is satisfactory as it is. Yes, you can use two pound cans if you wish.

DO YOU WANT SOMETHING better than the ordinary teasing needle? You can make it

yourself. Cut a single joint from a bamboo fishing pole. Split the joint into several pieces half the size of a pencil. Smooth the edges with a knife. With a razor blade fashion a long fine point on the end. You will be surprized at the results. These points are flexible and very sharp. In addition to the needle point they can also be fashioned into a spatula point with a round or square nose. When dulled they may be sharpened again. You might as well cut yourself another joint of bamboo you will make several of these.

THE TEASING NEEDLE idea was obtained from a parasitologist who circled the globe on a parasite collecting scholarship. Some fun. He said he also split bamboo and made a pair of tweezers. You will have to take it from here because I have not tried this. He claimed both of these items were good additions to a dissecting kit.

DO YOU SUBMIT GOVERNMENT REPORTS each month for your ethyl alcohol? This idea came from a couple of fellows in Milwaukee. They just eliminate the ethyl alcohol. They substitute methanol (synthetic) alcohol in the place of ethyl alcohol. They sighted these advantages. Methanol is cheaper. It can be used for any alcohol purpose except taken internally. It will mix in any proportions with distilled water and does not form a precipitate. Get the absolute synthetic methanol. When you get through with it dump it in your radiator for winter driving, if you wish, I do.

Lawn Care, published by O. M. Scoll and Sons Co., Marysville, Ohio, will be sent upon request. (This has been mentioned in the NABT before.) It is published five times per year and full of lawn hints.

PERHAPS YOUR SCHOOL has a practical lawn problem for its campus or football field. Speaking of lawns there is an excellent spray for broad leaved lawn weeds. The weeds are killed in a few weeks, for good, but it does not harm the grass.

SPEAKING OF FREE PUBLICATION, *The Living Museum*, published by The Illinois State Museum, Springfield Illinois, is mailed to folks in Illinois. Who ever edits it writes very interestingly, and knows public relations. Never knew there was such a thing as a state museum. Whether there is or not he has sold me on the idea that there is one. Perhaps you out-of-staters might get on the mailing list if you stated your case clearly.

DO YOU HAVE A GREENHOUSE? If you do fall is the time to start your pansy seed. Pansy plants do not thrive in hot weather. A little July sun and they are gone. Sow the seeds in seed flats or shallow frames or hot bed. Next spring they will have a head start and furnish you with an abundance of bloom for the early spring garden.

WHAT DO YOU DO with insect collections that students prepare and leave in the laboratory? The dry ones may be laxed and reshaped for museum display purposes. If you can get quantities of a particular insect commonly used in the laboratories in your area perhaps we can find a market, for them for you.
INSECT PINS are available. They were scarce items during the war. They are made in Czechoslovakia and related countries.

ELECTION NOTICE

(The Nominating Committee appointed by the Executive Board has submitted the following list of nominees for offices of The National Association of Biology Teachers for the ensuing year. The Secretary-Treasurer is sending ballots to all members.)

For President:
BETTY LOCKWOOD—B.S. Wayne University, Detroit, Michigan; M.A. Cornell University, Ithaca, New York; M.P.H. and D.P.H. Harvard University, Boston Massachusetts. Research Associate, Harvard School of Public Health Director of Nutrition Education; Formerly teacher of Elementary Science, General Science, and Biology at Detroit, Michigan; taught extension courses at Wayne University and Boston University. Contributor to *The American Biology Teacher, Science Education, American Association for Health, and Physical Education and recreation.* Author of *Source Books for Teacher and Students*, National Foundation for Infantile Paralysis; *Goals for Nutrition Education*, Guest Editor of *The American Biology Teacher*. Served as Second and First Vice-president of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS.

CLYDE T. REED—Head of Biology Department, University of Tampa, Tampa, Florida. A. B. Campbell College; M.S. in Zoology, Washington College; M.S. in Physiology, Cornell University; Graduate work, University of Chicago, University of Texas, and University of Michigan. Life Member of National Education Association; Honorary Life Fellow and Past President, Texas Academy of Science. President of the Florida Association of Science Teachers 1947–48.

For First Vice-President:
LEE R. YOTHERS—Biology instructor and head of Science Department, Rahway High School, Rahway, New Jersey; part time Zoology instructor at Union Junior College, Cranford, New Jersey. B.S. University of Pittsburgh; M.A. Teachers College, Columbia University, New York. Member of The American Association for The Advancement of Science, NATIONAL ASSOCIATION OF BIOLOGY TEACHERS, National Association for Research in Science Teaching, National Science Teachers Association, Central Association of Science and Mathematics Teachers, New Jersey Science Teachers Association. Associate Editor and contributor of *The American Biology Teacher,* Author of articles in other scientific journals; Guest-editor "Field Trip" issues I and II of *The American Biology Teacher.* Served two years on executive committee of the New Jersey Science Teachers Association, Biology section chairman and Vice-president; Past membership representative for the NATIONAL ASSOCIATION OF BIOLOGY TEACHERS; State Director for the National Science Teachers Association in New Jersey.

RICHARD L. WEAVER—B.S. Pennsylvania State College; Ph.D. Cornell University, serving as Pack Fellow three years. Taught for three years Biology, Nature Study, and Science Maumee Valley County Day School in Toledo, Ohio; three years at Dartmouth College; one year at the University of New Hampshire; now serving as Program Director for the North Carolina Resource-Use Education Commission assisting public schools, teachers' colleges, and non-school agencies to increase their emphasis on conservation, biology, science teaching, and wise resource use. Taught in summer camps at Oglebay, Wheeling, West Virginia; Lost River Nature Camp; and at Plymouth Teachers College, New Hampshire. For three years served as Educational Director of the Audubon Nature Center at Greenwich, Connecticut. Membership chairman for the Wilson Club for three years; secretary-treasurer of the American Nature Study Society since 1943; served as secretary of the New Hampshire Audubon Society and the North Carolina Bird Club. Regular contributor to *The American Biology Teacher* and to numerous other scientific and educational journals.

For Second Vice-President:
DOROTHY C. MILLER—A.B. Indiana Central College, Indianapolis, Indiana; M. A. Indiana University; Ph.D Cornell University, Ithaca, New York in Nature Study under Dr. E. Laurence Palmer. Has taught Biology in High School and Junior College and at present is Iowa State Teachers College, Science Department teaching Biological Science for the Elementary Teachers. First-president of Biological Section Indiana State Teachers Association; chairman of Camping Committee of the NATIONAL ASSOCIATION OF BIOLOGY TEACHERS. Professional interest: Improving Science Teaching, School Camping.

FRANCES GOURLEY.—B.S. and M.S. at the University of Illinois, Urbana, Illinois. Has taught in the following High Schools: Saybrook, Minonk, Beardstown Community High Schools, University of Illinois High School, Urbana, Illinois. MacMurray College, Jacksonville, Illinois. At present is at LaPorte, Indiana in the LaPorte Senior High School. Member of NATIONAL ASSOCIATION OF BIOLOGY TEACHERS, Indiana Academy of Science, Indiana Audubon Society, Wilderness Society, Washington, D. C. and the American Nature Study Society.

For Secretary-Treasurer:
JOHN P. HARROLD

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mention THE AMERICAN BIOLOGY TEACHER
when answering advertisements

Teaching Yeast Reproduction

JOSEPH P. McMENAMIN
Oak Park Township High School, Oak Park Illinois

This paper is written without any intention of minimizing the important role which the common baker's yeast has always played as a good example of a budding organism. The writer's purpose instead is to call to the attention of biology teachers and textbook authors the more complete story of yeast reproduction as revealed by a study of the literature of the last two decades.

In the ordinary text there is no mention of the fact that a few species of yeasts reproduce asexually by *fission* only. Nevertheless, on the very basis of recognizing their two methods of asexual reproduction, the true yeasts were once classified into two series: the *Saccharomycetaceae,* which reproduce asexually by budding only; and the *Schizosaccharomycetaceae,* which reproduce asexually by fission only.

Most teachers recall that the common baker's yeast was long considered to be entirely without sexuality. This concept was finally changed during 1935 when two Danish scientists, Winge and Laustsen, announced that they had observed conjugation among the cells of this lowly industrial plant*. By 1937 these workers had developed a micromanipulative technique by which they could actually remove, separate, and isolate the four spores of an ascus. (An "ascus" in yeasts appears simply as a cell, somewhat larger than the ordinary cell, and contains spores, usually four.) This enabled them to study these isolated spores in pure cultures. They not only suspected sexuality here but also a segregation of genetic factors.

In 1938 these same Danish scientists reported a method for hybridizing yeasts. This involved the placing of two haploid spores in a droplet of culture medium and allowing them to conjugate and thus produce a diploid zygote. From such a zygote various hybrids might be expected. These workers of the Carlsberg Laboratories in Copenhagen presented a technique as interesting to the scientific world as the one which applies to the hybridization of corn. It was not long before yeast hybridization was well underway. Matings were initiated and special strains sought. In 1943 Carl and Gertrude Lindgren of Washington University, St. Louis, Missouri, reported on segregation, mutation, and "copulation" in the common yeast.

Conjugation in yeasts is apparently achieved by the fusion of morphologically identical cells, that is, isogametes. In a few species however, there is a difference of size in the conjugating cells.

Painstaking research on the sexual reproduction of yeasts has brought to light three different types of life cycles:

1. The most common type is one in which the vegetative stage is haploid throughout. Conjugation here resembles that which occurs in the well-known *Spirogyra* in that the contents of the two yeast cells fuse after mutually forming a conjugation tube. Unlike this process in *Spirogyra,* however, the fused protoplasm is finally so distributed that it occupies both yeast cells after the fusion is completed. Owing to the nar-

* Sexual reproduction in yeasts was first clearly recognized by A. Guilliermond in 1902 in the genus *Schizosaccharomyces,* but not until the discovery of these Danish workers was the same method attributed to the common industrial yeasts.

row conjugation bridge which unites the two rounded yeast cells, the resulting spore sac or ascus is dumb-bell shaped.

2. In another type the vegetative stage is diploid instead, and the ascospores (produced by the reduction division) may actually conjugate within the ascus upon germination.

3. In the third type of life cycle there are two distinct generations, one diploid, and the other haploid. The haploid generation is of comparatively shorter duration.

Thus it can be seen that reproduction in yeasts is by no means a simple issue. In all stages of the life cycles strong tendencies toward asexual reproduction are said to exist. Incomplete conjugation has also been observed in which the conjugation tubes are formed but do not function. Teachers who might wish to read a more complete technical treatment of this subject should consult Henrici's paper published in 1941.

In consideration of the above facts it seems that, while budding (as commonly illustrated by baker's yeast) is general and typical of the asexual reproduction of most yeasts, fission should not be completely ignored. Moreover, sexual reproduction and the varied and complex life cycles in these otherwise simple organisms give them a biological status, both morphologically and genetically considered, which merits recognition both in our textbooks and in our class work.

Summary

1. Most yeasts reproduce asexually by budding only.

2. A few yeasts reproduce asexually by fission only.

3. Sexual reproduction by conjugation of similar cells (isogametes) occurs in baker's yeast besides the well-known budding process.

4. Three types of life cycles have been discovered among the various species of yeasts.

References

Guilliermond, A. 1920 *The Yeasts*, translated by F. W. Tanner, Wiley and Sons.

Winge, Ö. and Lausten, O. 1937 "On Two Types of Spore Germination and on Genetic Segregation in *Saccharomyces*, Demonstrated through Single-spore Cultures." *Compt. rend. trav. lab. Carlsberg, sér physiol.* 22: 99–117.

Henrici, A. T. 1941 "The Yeasts" *The Bacteriological Review* 5: 97–179.

Lindgren, Carl and Lindgren, Gertrude. 1943 "Segregation Mutation, and Copulation of *Saccharomyces cere visiae*." *Annals of the Missouri Botanical Garden* 30: 453–469.

THE ANNUAL MEETING

The annual meeting of The National Association of Biology Teachers will be held in Washington, December 27 to 30, 1948. The theme will be *The Role of Health in Biology*. The general plan of the meeting will be as follows:

Monday, December 27

7:00 P.M. Business Session

Tuesday, December 28

10:00 A.M. Joint Session with other science teaching societies of AAAS

2:00 P.M. NABT, What Current Health Needs Are Being Met by Recent Research?

7:00 P.M. Business Session

Wednesday, December 29

10:00 A.M. Joint Session

2:00 P.M. NABT, Integration of Health Factors with Biological Principles

6:30 P.M. Joint Dinner with ANSS, NABT and NSTA

Thursday, December 30

10:00 A.M. Joint Session, The Third Annual Junior Scientists Assembly

2:00 P.M. NABT, Teaching of Health as a Factor in Improvement of Human Relations.

The headquarters hotels are the Washington and the Willard. Less than a block apart, they are near the White House grounds. Members planning to attend should make their own arrangements with the hotels at least a week in advance. They should indicate that they are attending the meetings of the science teaching societies of the AAAS.

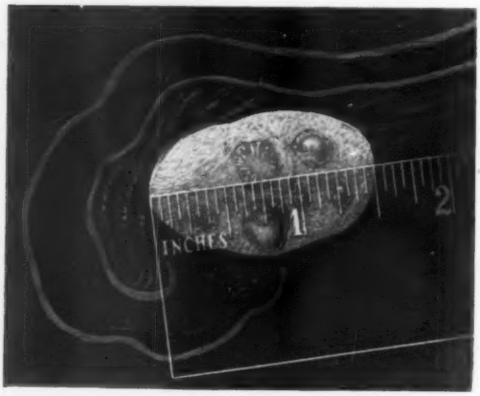
The full program will appear in the November issue.

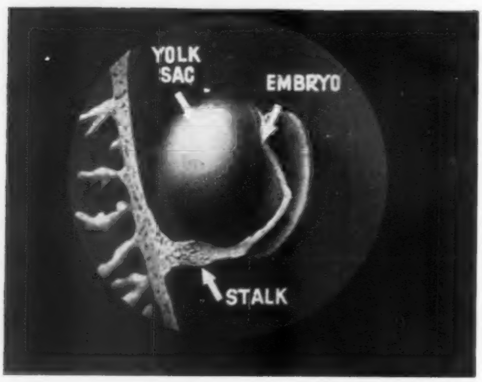
Films

TEXT-FILM ON HEALTH EDUCATION, *McGraw-Hill Book Co. Inc.*, New York.

The first complete public showing of McGraw-Hill's new Text-Films on Health Education was held at the Museum of Natural History on March 6. This presentation, attended by a group of some 500 persons working in health and allied fields, was part of the regularly scheduled Saturday morning showings sponsored by the Audio-Visual Aids Information Center of the Museum.

Films shown are all part of a series produced by McGraw-Hill for correlation with *Textbook of Healthful Living*, by Harold S. Diehl, Dean of the Medical Sciences at the University of Minnesota. The films illustrate functions and proper care of the body and the body's techniques of fighting off disease. One entitled "Human Reproduction," is an interesting factual film on the human reproductive system and on the process of normal human birth. Two pictures from this film are shown. The entire series, consisting of five 16mm. sound motion pictures and five silent follow-up filmstrips, is designed primarily for college and high school students. However, the films also have valuable implications for parent-teacher associations, child study groups, public health services, civic and religious groups, and student nursing classes.





Although these films are correlated directly with the *Textbook of Healthful Living*, and were designed for high school and college classes, they will be appropriate wherever the problems of individual or group health must be met.

All McGraw-Hill Text-Films are available to individual users and film rental libraries through direct purchase from McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, N. Y.

MATERIALS FOR TEACHING FOREST CONSERVATION

The following bulletins may be obtained from the United States Forest Service. The list is only a small part of the various materials made available by this agency. There are leaflets, pamphlets, audio-visual aids, charts, posters and the like; all are listed in leaflet K-28, which also includes an order blank. Write for K-28 or for any of the bulletins listed below to *United States Forest Service, Washington 25, D. C.*

BULLETINS

MP-162 *Our Forests, What They Are and What They Mean To Us.* 5¢. 38 pp. Tells what the forest really is, describes the forest regions, shows how our forests serve us, lists the enemies of the forests, gives a brief history of forestry in the United States, and proposes a sound program for achieving forest conservation.

MP-290 *The Work of the U. S. Forest Service.* 10¢. 32 pp. Emphasizes the

responsibilities of the Forest Service and its far-flung activities in administering the 175,000,000 acres of national forests. It describes Forest Service cooperation with the states, forest land owners, ranchers, forest industries, and farmers, to insure a perpetual supply of timber and other vital products from our forests and range lands.

MP-388 *Living and Forest Lands.* 10¢. 47 pp. A guide for study groups especially interested in the social and economic aspects of forests and forestry. Contains suggested classroom activities, questions for discussion, problems, evaluation tests.

MP-395 *Forestry for 4-H Clubs.* 10¢. 50 pp. Emphasizes getting acquainted with the forests and learning of their different values to their owners and their place in the economy of the farm and the community. Useful to 4-H Club leaders, Scoutmasters, and vocational agriculture teachers.

MP-543 *Some Plain Facts About the Forests.* 10¢. 22 pp. Tells of our serious forest situation and proposes a program for improving it.

MP-600 *Water and Our Forests.* 10¢. 29 pp. Stresses the importance of healthy, forested watersheds to insure adequate water supplies, protection against flood and erosion, forest products, ideal habitat for wildlife and attractive recreational facilities.

FB-1492 *Arbor Day, Its Purpose and Observance.* 10¢. 33 pp. Gives the origin of Arbor Day, describes its rapid spread, indicates the time of year Arbor Day is celebrated in the respective status, and relates it to forest conservation.

FB-1989 *Managing the Small Forest.* 20¢. 61 pp. Gives sound general advice on managing the small forest for the most profit. Particularly valuable to teachers of vocational agriculture and vocational forestry, as well as to farmers, county agents, and small woodland owners.

G-6 *Forest Fires and How YOU Can Prevent Them.* 12 pp. Shows that 90% of our forest fires are caused by mans' carelessness and thoughtlessness. Tells how they can be prevented.

Letters

Dear Sir:

To Mr. Lacroix' interesting article on the use of local fishes in aquaria I should like to add "Stock the Aquarium with Local Plants."

The aquarium of my childhood in Maine never had a purchased plant in it but it never lacked for plant growth. An aquatic *Ranunculus,* a sub-aquatic *Sagittaria* and a stonecrop are the ones I recall. My rule is to plant anything sub-aquatic that looks desirable: if it grows it is an acquisition, if it dies no harm is done. In Pittsburgh I found a good species of *Ludwigia* and plenty of the duckweed that goldfish will eat. From New Jersey came a feathery *Myriophyllum* that grew wonderfully. Stonewarts have seldom done well for me but one appeared once and grew very well for some months. In this dry Northwest few good water plants can be found but a small *Potamogeton* sometimes grows and I once found a little bladderwort. The smaller species of *Elodea* that grows so thriftily can often be found in ponds or streams where it sometimes becomes a nuisance.

I would like to add to Mr. Lacroix' list of fishes the yellow perch, which takes kindly to captivity as well as almost any of the shiners, minnows or chub. The speckled dace of local streams is proving to be a very good aquarium fish. Bass or white perch are all right too if not too large.

Tadpoles are good if the fish are small and not of aggressive species but I have seen many of them swallowed or worried to death by fishes, particularly when their hind legs appear to give the fish a hold. The eastern water newt is a very interesting animal too, sluggish but appealing because of its almost human look. Clams of small size are easy to get and often live for some time. In Maine we found a tiny one, probably *Cyclas,* that thrived for a long time and bred in the aquarium. I have a large one in my aquarium now that plows furrows around the outside edges of the sand, uprooting any water plants that come in its way but doing no harm otherwise.

So may I advise all fellow aquarium fans to experiment freely with local plants and animals and wish them all good luck.

Sincerely,

PHILIP H. POPE,
Whitman College
Walla Walla, Washington

Dear Sir:

In a great many cases where trademarks are used in scientific and other literature, the trademarks are not capitalized or set in quotation marks. One unaware of the facts might readily conceive the trademark to be merely a descriptive term. We wish to call your attention to this situation, and suggest a uniform manner of identifying all trademarks where they appear in published articles.

The trademark is a valuable property right of the manufacturer and once adopted, its value depends upon keeping it in use as a trademark. We are all aware of the fact that the trademarks "Aspirin" and "Cellophane" were lost through appropriation of these marks by the public. They became a part of the common language. This could have been prevented, in part at least, if in use these two terms had always been clearly identified as trademarks.

The practice of using trademarks to indicate the source and the genuineness of pharmaceuticals and chemicals has increased significantly in recent years. Under such circumstances, it is natural that trademarks appear with increasing frequency in the scientific literature.

A trademark is properly identified as such if it begins with a capital letter, or if the word is placed in quotation marks.

We trust that you will receive this request in the spirit in which it is sent. To those writers and editors who have kept the proper delineation of trademarks in mind, we wish to extend our sincere thanks. The members of our Association spend millions of dollars annually to sponsor various research projects. The scientific knowledge resulting from this work is of real value. We feel that readers of the literature should be informed that certain words are in fact trademarks which identify the source of genuine material.

Sincerely yours,

American Drug Manufacturer's Ass'n.,
Washington, D. C.

Books

SWAIN, RALPH B. *The Insect Guide.* With illustrations by Suzan N. Swain. Doubleday & Company, Inc., Garden City, N. Y. xlvii + 261 pp. Over 450 illustrations, 330 in full color.

For many years teachers of biology have been looking for just this type of insect guide. Written by an experienced, well-trained entomologist, and illustrated by his skilled artist wife, it is the product of a team with all the qualifications necessary to produce a work both accurate and comprehensive. In addition, however, it has been organized with a unique understanding of the requirements of a layman in entomology. In this respect it offers a new approach and attains its goal with rare success.

The layman who is an amateur but sincere ornithologist has no difficulty in learning to recognize and name a hundred species of birds. But a layman who could name only a hundred species of insects would have but a meagre start toward naming those in his own yard alone. Dr. Swain recognizes, rightly, that the best way to get a general view of the insect world is to work for a recognition of major groups—orders and families—not species. After all, even an entomologist knows relatively few *species* of insects, and most biologists are little more than laymen themselves in the whole field of entomology. Why not recognize this fact and strive first of all for a birds-eye view of the kinds of insects?

With this in mind, Dr. Swain has selected the principal families of insects occurring in North America north of Mexico. He has recognized 175 families in this category. Every family is illustrated by one or more typical representatives most of these in color, in a series of fifty-six plates in the middle of the book. By a system of consecutive

numbers which correspond to the illustrations one may readily use the illustrations as a visual key to be supplemented by reference to text material. This is, of course, the way a layman uses illustrations in an identification manual. In the text, under each order is a general discussion followed by general descriptive material for each family in that order under the headings "Adults", "Young", "Importance". For those interested in knowing the species illustrated the scientific name of each such species is given, with a brief annotation on distribution and abundance.

The introductory material contains a concise summary of the place of insects in nature and instructions on the use of the guide. At the end of the family descriptions there is a section on collecting and studying insects, followed by a carefully selected list of references for further study and an index which includes references to both text and illustrations. The end papers summarize, in table form, the characteristics of insect orders.

The authors and publishers may indeed be proud of this book. The illustrations are superb; they are not merely accurate, they are beautiful. The text is extremely well organized, clearly written, and contains a wealth of information. The price, three dollars, is quite reasonable. As a general insect guide we can forecast a very successful future for this work.

GORDON ALEXANDER,
University of Colorado,
Boulder, Colorado

Science and Security

E. U. CONDON

(Continued from May issue)

The difficult problem here is to know where to draw the line. I am strongly of the opinion that the research scientist needs to feel free to get any information he wants from other branches of the research organization. There is a certain small extra risk if the man proves to be unreliable but one more than makes up for it in the increased effectiveness with which he can work. That there is no general agreement on policy here is shown by the fact that there are a great variety of opinions on this subject which have found official aceptance.

For example, the British seem to have followed the policy, among high level personnel, of giving them free access to anything whatever. The men were, of course, asked not to waste their time by unnecessary visiting around, but each individual was allowed to be the judge of that. The contrast between the American and British systems was especially striking on the atomic bomb project, after our British friends came over in large numbers in the fall of 1943 to give us their help on the job.

The Americans were bound by strict rules of compartmentalization. It was extremely difficult to get information from one part of the project if you were on another part even though a clear need existed. What made matters more difficult was the fact that because of such secrecy one often did not know whether the desired information existed or where to go to ask for it.

The British, however, had no such rules and this was a great benefit to us Americans, for the British were able to supply badly needed data, the lack of which might have seriously delayed our work, in several phases of the project. The moral here is self-evident: excessive compartmentalization threatens our own goals.

The Disclosure of Scientific Secrets

This brings me to my next point, one that has often been stressed by other students of this subject. It is the *extreme difficulty of giving away scientific secrets.* I have never tried to do it, so I have no first-hand knowledge in this context. But I should imagine it would be rather like teaching. All of us have experienced the teaching process as receivers and some of us have also tried to serve on the transmitting end. Of course, if the secrecy goes so far as to include the mere fact of the existence of a project on a certain subject, such a secret can be given away without difficulty. But the amount of essential detail even with regard to principles and especially with regard to specific designs, that inheres in any modern scientific military device is fantastically great. To give

away such secrets one would have to transfer vast quantities of drawings and documents. Even those are usually so unclear without explanation that the receiver would need to be given a special course of instruction in their meaning. Even this, to be really effective, requires the receiver to be a man of high scientific and technical training.

This is not to condone indiscretion or carelessness but simply to point out that giving away technical secrets is not so easy as it might seem to the uninitiated. I feel sorry indeed for any modern Mati Hari who might be assigned to get the secret of the atomic bomb by working her wiles on a young army sergeant.

Security in the Broader Sense

Let me return briefly to "security" in its more general and civilian sense: "freedom from fear, anxiety, or care; confidence of power or safety." What a splendid thing is security and how eagerly do all human beings crave it! Considering that every kind of human maladjustment, be it real or arising from erroneous beliefs or misinformation, gives rise to fear, anxiety or care, we see that nearly all human difficulties could be resolved if we would only find out how to achieve security.

Kinds of security are best classified in terms of the kinds of insecurity which deprive us of feeling secure. These may be grouped into four main headings:

(1) Anxiety of the individual concerning his place within the social groups to which he belongs;

(2) Anxiety of minority groups concerning their place in the national community;

(3) Anxiety of the national community as a whole concerning avoidance of economic depression;

(4) Anxiety of the national community concerning avoidance of war with other such groups.

All of these are very real, often bitterly tragic anxieties. Perhaps the most bitter and the most compelling one now is the last—in a period which has seen two major wars and scores of so-called "minor" wars in less than half a century. This anxiety today weighs down every civilized human being in the world; it is this anxiety beside which all others seem trivial.

The only way to security in international relations lies in a devotion to study of the social problems confronting mankind as a whole. This calls for an undreamed-of development of all the social sciences, and their application to social problems in a spirit of high responsibility. This calls for an approach to such problems which is not limited by traditional thinking in terms of group rivalries of any kind. It will not be easy, just as it is not easy to develop supersonic jet planes and guided missiles.

Getting down to the particulars of the present situation, we should recognize that there is no defense against the atomic bomb. There is no defense against ordinary bombs, for that matter, as the cities of Europe clearly attest. The old cliche that there is always a defense to every weapon of defense should be revised to read, there is an *attempted* defense to every weapon of defense.

In short, the greatest contribution to real security that science can make is through the extension of the scientific method to the social sciences and a solution of the problem of complete avoidance of war.

This means that we must be willing to invest the time, the people, the funds in developing and applying these methods. If we feel the short range security that military strength provides valuable enough to spend approximately 17 billion dollars next year, we should be prepared to sacrifice in a commensurate manner for those activities which alone give hope of the avoidance of war. Thus we should not balk at \$0.3 billion for Federal aid to education, which promises us better, wiser, more productive citizens; or at \$0.010 billion for a National Science Foundation, designed to embrace fields presently over-looked; or at \$0.007 billion on UNESCO.

Perhaps man, with his relatively short history, has neither learned his lessons well nor progressed far enough intellectually and spiritually. Perhaps his history for some time to come will be an unhappy and tragic one: this is our problem. It will not wait; nor can it be evaded.